

NOAA Protected Species Conservation and Recovery with States Program

**Sea Turtle Tagging and Health Assessment Study in the
Maryland Portion of the Chesapeake Bay**

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Final Report

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Abstract

Determining the distribution, abundance, and population status of sea turtles in the marine environment is important for the recovery and protection of sea turtle populations listed under the Endangered Species Act. The Chesapeake Bay was identified as an important area to determine seasonal distribution, specific habitat requirements, movements and growth of sea turtles. To begin to answer these questions, in 2001 the Maryland Department of Natural Resources (MD DNR) initiated a study of sea turtles incidentally captured in pound nets in the Maryland portion of the Chesapeake Bay. In June 2006 MD DNR received federal funds through the NOAA Protected Species Conservation and Recovery with States Program to continue this study. The objectives of the project were to support existing personnel, to examine 20 sea turtles incidentally captured in pound nets, to continue current sampling protocols and analysis, and to expand the scope of work to include contaminants analysis. During the grant period MD DNR personnel examined thirty-five sea turtles (ten loggerheads, 23 Kemp's ridleys and two green sea turtles). Each animal was measured, weighed, sampled for tissue and blood, tagged (flipper and PIT tags), and released. Based on curved carapace measurements all of the animals examined were juveniles. Four recaptures occurred during the grant period, demonstrating both localized movements within the Chesapeake Bay during the summer months as well as migratory movements along the East Coast of the United States between seasons. Blood samples were collected from 30 of the 35 turtles examined and sent to Antech Diagnostics for analysis. A summary of blood work results for the entire project period are presented and compared with results from other in-water studies along the East Coast. Tissue samples were collected from eleven sea turtles for genetic analysis. Eighty-nine archived blood samples were submitted at the end of the grant period to the National Institute of Standards and Technology for perfluorochemicals (PFCs) analysis. The overall goal of this project is to provide a better understanding of seasonal distribution, movements, genetic origin and baseline health of sea turtles in the Maryland portion of the Chesapeake Bay. This information will contribute to a

more comprehensive understanding of sea turtles on a regional and global scale, which is important for the development of effective management strategies for these protected species.

Introduction

Sea turtle populations worldwide have experienced a dramatic decline in numbers over the past several decades as the result of uncontrolled harvesting for food, jewelry and product consumption, destruction of nesting habitat, marine debris, collision with boats and commercial fishing activities, particularly shrimp trawling (NRC 1990). As a result, all five species of sea turtles that spend part of their lives in U.S. waters of the Atlantic Ocean and the Gulf of Mexico are listed as endangered or threatened under the Endangered Species Act of 1973. Federal recovery plans were developed for all five species that delineated reasonable actions believed to be required to recover and protect a species (NMFS & USFWS, 1991, 1991a, 1992, 1993; USFWS & NMFS 1992).

Historically, the majority of sea turtle research has focused on nesting beaches. Although sea turtles spend less than 1% of their lives on land, approximately 90% of the literature is based on nesting studies (Bjorndal 1999). This research is limited in scope, however, because it provides no information on juveniles or adult males. In order to achieve positive or stable long-term population growth for these long-lived, slow-growing species it is critical to have high survival rates in the juvenile and adult life stages (review in Heppell et al. 2003). To ensure survival, we must understand the migratory and foraging cycles of these life stages, or, where they spend their time when they are not nesting (USFWS & NMFS 1992).

Four species of sea turtles-greens, leatherbacks, Kemp's ridleys and loggerheads-have been documented in Maryland waters. The federal recovery plans for each of these species call for the study of seasonal distribution, abundance and migratory pathways in nearshore habitats, bays and sounds, including the Chesapeake Bay. The Virginia Institute of Marine Science (VIMS) has studied sea turtles in Virginia's waters of the Chesapeake Bay for several decades, and has documented that juvenile sea turtles, particularly loggerheads and Kemp's ridleys, utilize the Bay seasonally as a foraging habitat (Lutcavage and Musick 1985; Keinath et al. 1987). While efforts have been made to study sea turtles in Virginia, research in Maryland's waters of the Chesapeake Bay was limited until recently. To contribute to the successful implementation of the federal recovery objectives, there is a significant need for more information on sea turtle distribution, movement, health, sex and growth in Maryland.

To begin to answer these questions, in 2001 the Maryland Department of Natural Resources (MD DNR) initiated a study of sea turtles incidentally captured in pound nets in the Maryland portion of the Chesapeake Bay. A pound net is a passive, stationary gear that incidentally captures turtles but allows them to feed and surface to breathe. Incidental captures in pound nets provide a unique opportunity to study live specimens that might otherwise be inaccessible in Maryland waters, and have also been utilized in Virginia, North Carolina, and New York. MD DNR works cooperatively with watermen to retrieve sea turtles incidentally captured in pound nets. Turtles are measured, weighed, sampled for tissue and blood, tagged and released. The overall goal of this project is to provide a better understanding of the biology and ecology of sea turtles in the Maryland portion of the Chesapeake Bay, which will address several priority

actions identified in the federal recovery plans for these species that are believed to be required to recover and protect their populations.

The use of flipper and PIT tags has value in determining reproductive characteristics on nesting beaches, growth rates and overall long distance movements. Over time recaptures of tagged turtles will provide a detailed profile for each turtle that consists of morphometrics at first and subsequent recaptures, date of first capture, locations of captures and time-at-large between captures. This type of information provides the basis for estimating demographic parameters including mortality rates, recruitment rates, annual remigration rates and sex-, size- and age-specific growth rates necessary for predictive population modeling (review in Chaloupka and Musick 1997; NMFS & USFWS 1991, 1991a).

Tissue samples collected from loggerheads and greens will be analyzed to determine the genetic origin of sea turtles found in Maryland's waters of the Chesapeake Bay. Genetic information can provide insight into aspects of reproductive behavior and ecology, including nesting site fidelity, documentation of natural hybridization, genetic composition of sea turtles in feeding grounds, the level of gene flow mediated by males and whether males return to their natal rookeries or mate with females from other nesting beaches (Bowen and Karl 1997). This information has important implications for defining sea turtle management units and taking appropriate conservation measures to protect them.

Together with efforts to restore threatened or endangered sea turtle populations to historic levels, increased attention has been focused on assessing the health and physiological status of these populations (Lutz and Dunbar-Cooper 1987; Bolten and Bjorndal 1992; Jacobson et al. 2005). Blood collected by MD DNR will aid in determining "normal" values for free-ranging loggerhead and Kemp's ridley sea turtles, which are generally lacking for wild populations (Bolten and Bjorndal 1992). In addition to providing an indication of the overall health of a wild population, these values could be useful in diagnosing and treating captive and sick and injured sea turtles in rehabilitation and for improving guidelines for release criteria of stranded sea turtles.

Another area of growing interest involves the effects of environmental contaminants on the health, survival and reproduction of sea turtle populations (Keller et al 2004, 2004a; Keller et al 2005; Lake et al. 1994). Toxicologists at the National Institute of Standards and Technology (NIST) in Charleston, SC, have been monitoring and investigating the associations between inorganic and organic contaminant concentrations and clinical health parameters in sea turtles. Of particular interest are mercury and a variety of organochlorine compounds, including polychlorinated biphenyls (PCBs), organochlorine pesticides (OCs) and perfluorochemicals (PFCs). Preliminary results indicate negative correlations between contaminant concentrations and several health indicators, suggesting that certain levels of contaminants may be capable of inducing immunosuppression in free-ranging sea turtles (Keller et al. 2004, 2004a; Keller et al 2005; Day et al. 2005). To date, much of this work has focused on samples collected from sea turtles in the southeastern United States. To further understand the effects of contaminants on sea turtle health, additional populations that may be exposed to higher levels of contaminants should also be investigated (Keller et al. 2004a). Therefore, to expand the scope of research to include

the Chesapeake Bay, MD DNR provided blood samples collected in this project to NIST for contaminants analysis.

Project Goal and Objectives

The overall goal of this project was to provide a better understanding of seasonal distribution, movements, genetic origin and baseline health of sea turtles in the Maryland portion of the Chesapeake Bay. To achieve this goal, MD DNR proposed to continue a pound net tagging and health assessment study, or more specifically, to 1) support existing personnel, 2) to examine up to 20 sea turtles incidentally captured in pound nets, 3) to continue current sampling protocols and analysis, and 4) to expand the scope of work to include contaminants analysis.

Methods

Field Season Preparation

MD DNR biologists rely on the incidental capture of sea turtles in pound nets to acquire subjects for this study. Initial reports come from commercial watermen who encounter the turtles while fishing their pound nets. The success of this study is dependent upon the continued cooperation of commercial watermen in the Chesapeake Bay. As a result, it is imperative that efforts are made to contact pound netters throughout Maryland's Chesapeake Bay to solicit help with the study. In May 2006 postcards were sent to approximately 150 pound netters who are registered with MD DNR to participate in the striped bass pound net fishery. While there are more pound netters registered with the state, those fishing for striped bass must register every year, so the agency was sure that these 150 individuals were actively fishing pound nets in the Chesapeake Bay. The postcard described the tagging study and asked for assistance with the project. It also provided contact information for Tricia Kimmel, the Principal Investigator (P.I.) for this project, for those watermen interested in participating in the upcoming tagging season. In addition to the handful of watermen that have participated in the project in years past, two new watermen indicated they were interested in participating in 2006.

To prepare for the upcoming tagging season, the P.I. updated the MD DNR tagging and health assessment protocols, data sheets, and contact lists to reflect changes in procedures and to include contact numbers for participating watermen. MD DNR biologists purchased supplies for the sampling season including PIT and flipper tags, surgical scrub and blood collection tubes. To facilitate blood drawing MD DNR personnel built a "turtle chair" that would safely immobilize an animal, thereby reducing the likelihood of injury to both the turtle and examiner (Figure 1). The P.I. held a training session in early May with MD DNR project staff to go over proper handling and sampling techniques for the tagging study.



Figure 1. Sea turtle chair used during examinations to immobilize an animal.

Sea Turtle Sampling Methodology

MD DNR biologists have studied sea turtles incidentally captured in pound nets since 2001 under the authority of an ESA Section 10 scientific research permit (#1262) issued to MD DNR. Sea turtles are obtained through the cooperation of commercial watermen, who report incidental captures to MD DNR via phone or pager. Following protocols to keep the animals cool and minimize stress the watermen transported turtles dockside and placed them in shaded tubs or tanks until MD DNR personnel arrived to examine the turtles. Watermen received compensation of \$75 for assisting with the retrieval of an incidentally captured sea turtle.

Each turtle was photographed and given an identification number. Standard morphometric data (straight and curved carapace lengths and widths), weight, physical descriptions and net location were recorded. The turtles were examined for signs of disease, injury, and tags or tag scars. Sick or injured sea turtles were transported to the National Aquarium in Baltimore for rehabilitation (see below for more information). The examination time was approximately 20 minutes and the animal was kept shaded and moist throughout the examination. After the exam turtles were released on site. All data, including blood work results, were entered into a Microsoft Excel spreadsheet and folders were created for each animal to house datasheets and hard copies of diagnostic results.

Blood Sampling

Blood samples were used to evaluate sea turtle health using widely recognized diagnostic parameters. Three blood parameters (hematocrit, total protein and glucose) were determined in the field while a professional diagnostic laboratory, Antech Diagnostics (Lake Success, NY), was contracted to analyze 28 blood parameters for each sample.

Sea turtles were placed in a restraining chair (head down, plastron flush to the chair) for collecting blood samples. Blood samples were collected from the dorsal cervical sinus (Owens and Ruiz 1980). The venipuncture site was cleansed with Betadine and 70% ethanol prior to sampling. Two 0.6 ml lithium heparin gel microtainer tubes were filled with whole blood, 0.1 ml of blood was placed into a microtainer with EDTA and any remaining blood was placed in a red

top serum separator tube. Blood was also drawn into four micro-capillary tubes to determine hematocrit. All blood samples were placed in a cooler for transport back to the laboratory. Blood glucose was determined in the field using 1-2 drops of whole blood and a ReliOn Ultima Blood Glucose Monitoring System for comparison with professional laboratory results.

In the lab blood smears were produced with whole blood from the EDTA tube. The two lithium heparin microtainers were centrifuged and refrigerated. Hematocrit was determined by centrifuging two micro-capillary tubes for 5 minutes and then measured using a capillary tube reader. Total protein was determined using centrifuged plasma placed on the lens of a refractometer. The red top tube was centrifuged and serum was pulled off and archived in an -80° C for future diagnostics. The remaining two hematocrit tubes, lithium heparin microtainers, and blood smears were sent to Antech for analysis including a comprehensive reptile chemistry panel, Complete Blood Chemistry (CBC), testosterone assay, and parasitology. A report was generated and faxed to the P.I.. The data was entered into a Microsoft Excel spreadsheet.

Tagging

Turtles without existing tags were tagged in each front flipper with external Style 681 Inconel tags provided by the Cooperative Marine Turtle Tagging Program at the University of Florida. The tagging site was the second scale on the trailing edge of each of the front flippers. Prior to tagging, each site was cleansed with Betadine and 70% ethanol. All turtles were also tagged with a passive integrated transponder (PIT) tag (TX1450B, Biomark, Inc. Meridian, Idaho). Prior to tagging, each turtle was scanned with a Destron Pocket Reader for the presence of existing PIT tags. The tagging site, which was the triceps superficialis muscle of the left front flipper, was disinfected prior to insertion of the tag. All tag numbers and locations were recorded on the datasheet.

Skin Sampling

A skin biopsy was taken from each animal using a 6 mm Acu-Punch (Acuderm, Ft. Lauderdale, FL) and preserved for genetic analysis in a vial containing a saturated salt 20% DMSO solution at 4° C. The sampling site was the posterior edge of a rear flipper. Samples were not collected from Kemp's ridleys because the species has only one major nesting site in Rancho Nuevo, Mexico.

Recaptures

Recaptured turtles were measured, weighed, sampled for blood, photographed and released. If a turtle was not originally tagged as part of this project, the P.I. contacted the Archie Carr Center for Sea Turtle Research to facilitate exchange of tag information to determine where and when the turtle was originally tagged.

Contaminants Analysis

Another objective outlined in the Section 6 proposal was to expand the current scope of work to include contaminants analysis, specifically perfluorochemicals (PFCs). MD DNR proposed to

submit archived blood samples to graduate students from the College of Charleston working in collaboration with the National Institute of Standards and Technology (NIST) for analysis as time and funding at NIST permitted. As described in the blood sampling section, extra blood collected in the field was placed in a red top serum separator tube and centrifuged and serum was pulled off and placed in an -80° C freezer.

Project Findings

Sea Turtle Sampling Response

2006

Thirty-three sea turtles (nine loggerheads, 22 Kemps' ridleys and two green sea turtles) were examined in 2006 (Table 5). This is the greatest number of turtles examined in a single season since the project began in 2001. The previous record was 23 turtles in 2003. The reason for the increased number of turtles is not clear and was not the result of additional participation by commercial watermen. Reported captures occurred between May 15 and August 29, 2006, with the majority in July (Figure 2). The peak in July is the result of one week in which seven sea turtles were examined, which is almost twice as many turtles as in any other week that month (Figure 3).

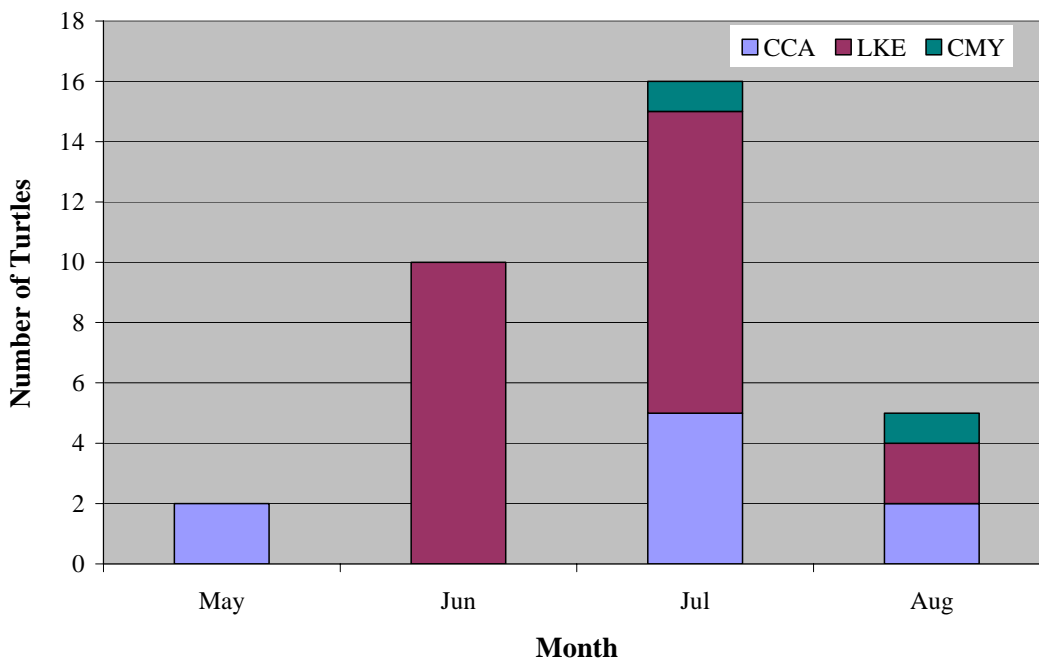


Figure 2. Monthly distribution of incidental captures of sea turtles in pound nets in 2006. CCA = loggerhead, LKE = Kemp's ridley, CMY = green sea turtle.

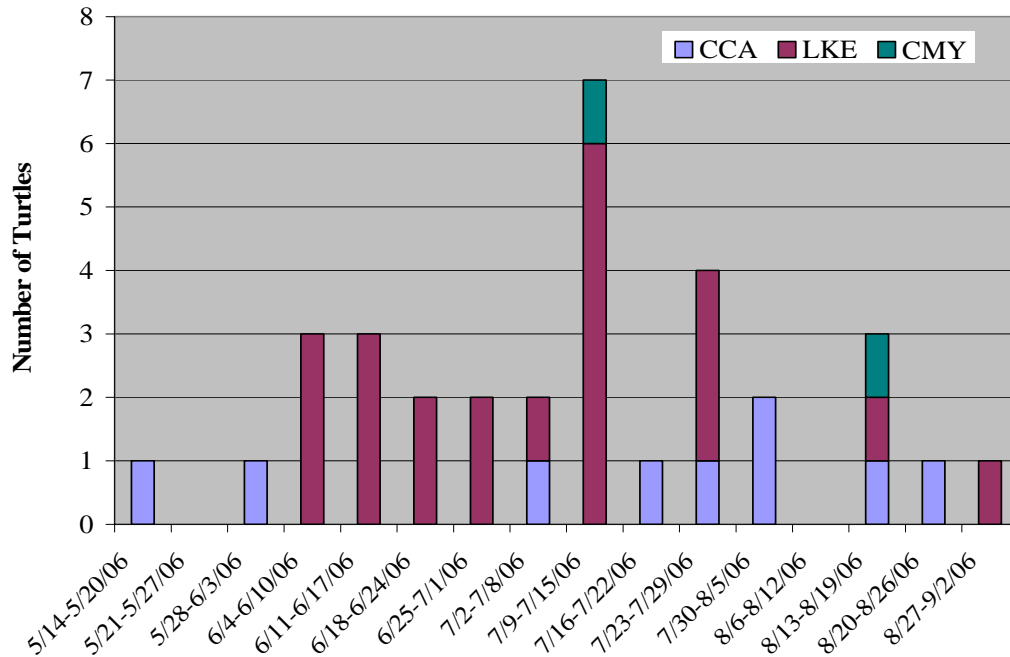


Figure 3. Weekly distribution of incidental captures of sea turtles in pound nets in 2006.

The nine loggerheads ranged in size from 52.3 to 82.0 cm curved carapace length (CCL, notch to tip; Figure 4) and 41.7 to 173.0 pounds. The 22 Kemp's ridleys ranged in size from 29.4 to 55.1 cm CCL and 7.0 to 43.1 pounds (Figure 4). The green, which was captured twice, was 28.0 cm and 5.8 pounds at the first examination and 29.5 cm and 4.2 pounds at the second examination a month later. The decrease in weight may be real or the result of variability among examiners.

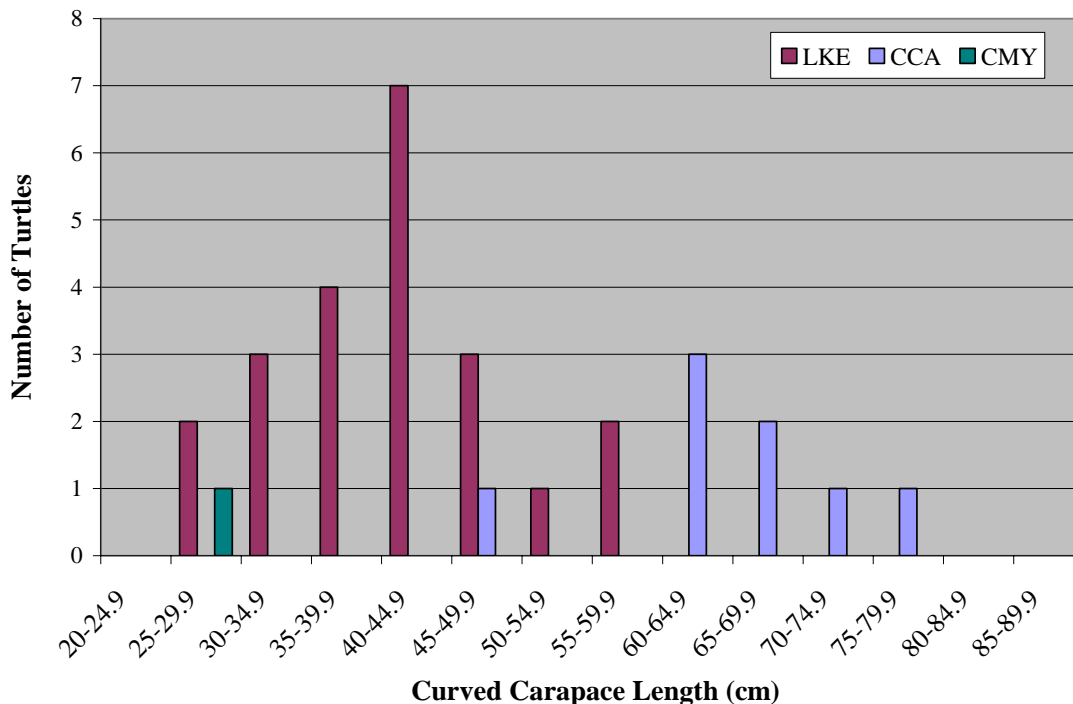


Figure 4. Length frequency distribution of sea turtles incidentally captured in 2006.

The 2006 reports came from five pound netters and turtles were found in a total of ten different net sites in the Chesapeake Bay (Table 1; Figure 6). The captures northwest of Hoopers Island occurred in three different nets registered to the same individual pound netter, while captures in Fishing Bay occurred in six different nets registered to three different pound netters. A single turtle was captured in a net in Pocomoke Sound.

Table 1. Distribution of incidental captures of sea turtles among net sites for 2006. Number(s) in parentheses indicate recaptures. CCA = loggerhead, LKE = Kemp's ridley, CMY = green sea turtle.

Net Site	# of nets	CCA	LKE	CMY	Total
NW of Hoopers Island	3	5 (1)	4 (1)	0	9
Pocomoke Sound	1	1	0	0	1
Fishing Bay	6	3	18 (1)	2 (1)	23
Totals	10	9(1)	22 (2)	2 (1)	33 (4)

Four recaptures occurred during the tagging season; 3 from this project and one recapture from another tagging study (Table 2). Two of the recaptures from this project occurred within the tagging season (06-PN-CC-29 and 06-PN-CM-31). Each of these turtles was recaptured in the same general vicinity as their original encounter (Hoopers Island and Fishing Bay, respectively), but in a different net. These recaptures suggest localized movements in the Chesapeake Bay during the summer months. A Kemp's ridley originally tagged as part of this project in July 2005 in Fishing Bay was recaptured in a different net in the same general area in July 2006, suggesting possible site fidelity to a specific location within the Bay over consecutive years. The fourth turtle, a Kemp's ridley (06-PN-LK-13), was originally tagged by researchers at the NMFS Beaufort Lab in Core Sound, North Carolina in July 2004 and recaptured in the Chesapeake Bay in July 2006. Besides providing information on growth rates (this turtle grew more than 8 cm in two years), this recapture illustrates migratory movements by a juvenile sea turtle along the East Coast of the United States.

Table 2. Summary of recaptures in sea turtle tagging study in 2006. The accession number presented refers to the date of recapture and not the initial capture date. CCA = loggerhead, LKE = Kemp's ridley, CMY = green sea turtle.

Accession #	Species	Date of Initial Capture	Location	CCL (cm)	Date of Recapture	Location	CCL (cm)
06-PN-LK-21	LKE	7/6/05	Fishing Bay	39.4	7/13/06	Fishing Bay	42.2
06-PN-CC-29	CCA	7/7/06	Hoopers Island	52.3	8/14/06	Hoopers Island	55.0
06-PN-CM-31	CMY	7/12/06	Fishing Bay	28.0	8/14/06	Fishing Bay	29.5
06-PN-LK-13	LKE	7/20/04	Core Sound, NC	34.2	7/7/06	Hoopers Island	42.8

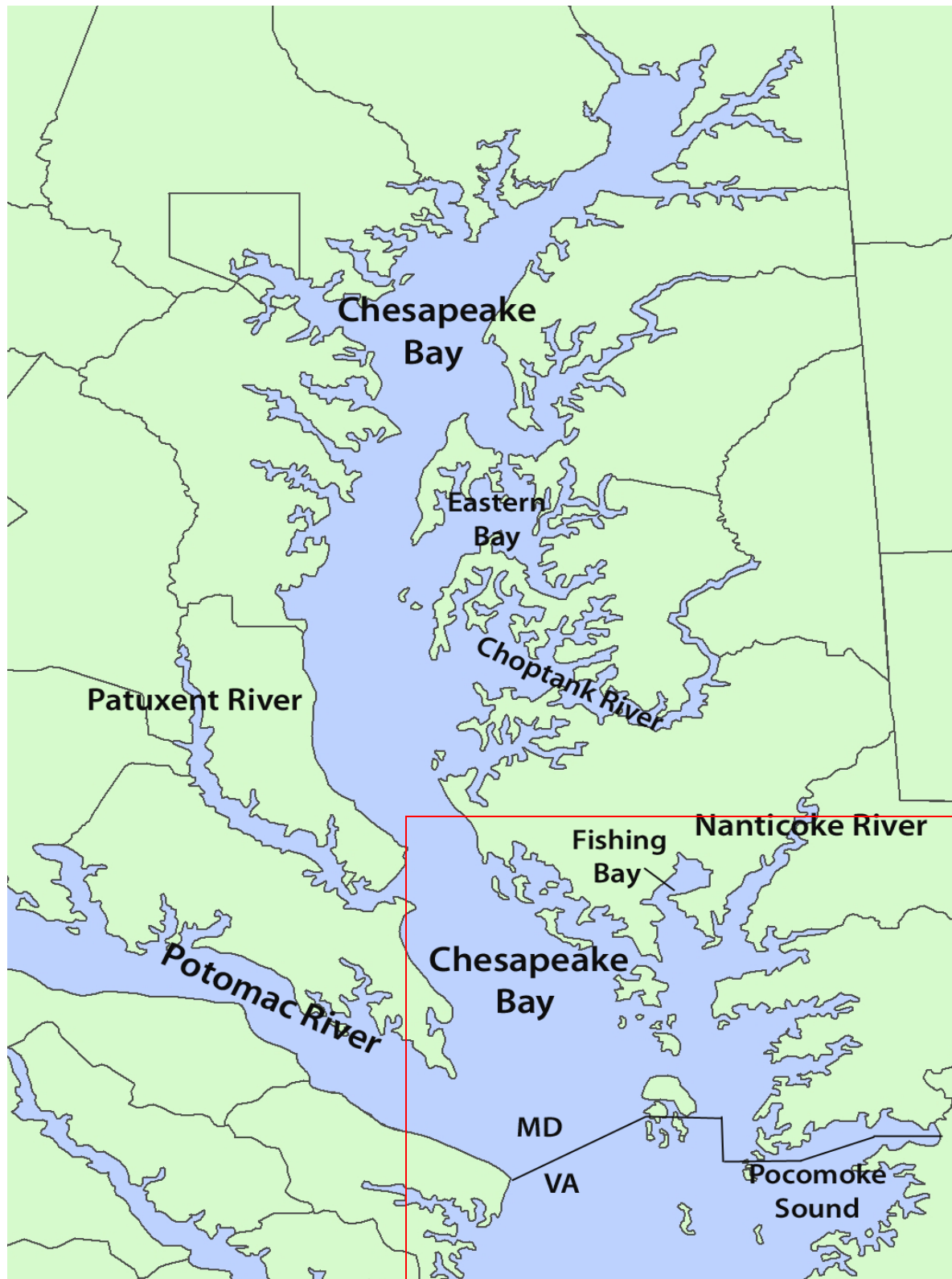


Figure 5. Map of study area. Red box indicates area in which sea turtles were incidentally captured in pound nets in 2006. See Figure 6 for specific locations of pound nets.



Figure 6. Locations (red stars) of pound nets in which sea turtles were incidentally captured in 2006 and May 2007.

Two sea turtles examined as part of this project were found to have injuries resulting from entanglement in hook and line gear. The injuries did not result from incidental capture in a pound net. A Kemp's ridley examined on July 7, 2006 was found to have a fishing hook embedded in its esophagus, with monofilament line protruding from the corner of its mouth. After several unsuccessful attempts to remove the hook in the field using a NOAA issued dehooking kit, MD DNR biologists transported the turtle to the National Aquarium in Baltimore (NAIB) for further evaluation. Using endoscopy to pinpoint the exact location of the hook, NAIB veterinarians were able to safely remove it using a dehooker. The turtle underwent rehabilitation and was released two miles off the coast of Ocean City, Maryland on September 8, 2006. The turtle was fitted with a satellite transmitter, which ceased transmitting in mid-October. The last transmission placed the Kemp's ridley ("Geddy") in the Chesapeake Bay near the Virginia/Maryland state line (<http://www.aqua.org/geddytracking.html>).

The second injured sea turtle was a loggerhead with a severe right front flipper entanglement brought in by a concerned pound netter. Several bottom rigs were wrapped around the flipper, which was nearly amputated and necrotic. MD DNR biologists transported the turtle to NAIB, where veterinarians successfully amputated the flipper at the shoulder. After three months of rehabilitation the turtle (“Ed”) was released off Frisco Beach, North Carolina on November 13, 2006. Ed was also fitted with a satellite transmitter and as of May 2007 when the satellite tag ceased transmitting he was off the coast of Myrtle Beach, South Carolina (<http://www.aqua.org/tracked/index.html>). Without the cooperation of commercial watermen through this tagging project these two turtles most certainly would have died from their injuries.

2007

The 2007 sea turtle tagging season got underway just as the grant period came to an end. Two sea turtles were examined in May 2007; a loggerhead and a Kemp’s ridley. The Kemp’s ridley measured 40.0 cm CCL, notch to tip and weighed 12 pounds and the loggerhead measured 62.0 cm CCL and weighed 46.1 pounds. The Kemp’s ridley was found in a net near Fishing Bay and the loggerhead in a net near Hoopers Island (Figure 6). A blood sample was collected from each turtle and a tissue sample was collected from the loggerhead for genetic analysis.

On May 22, 2007 a Kemp’s ridley tagged by MD DNR in June 2006 was recaptured in a pound net just south of the Potomac River in the Virginia portion of the Chesapeake Bay. The recapture was reported by VIMS. In a period of 11 months the turtle grew from 41.7 cm to 47.8 cm and returned to the lower portion of Maryland’s Chesapeake Bay, albeit on the opposite shore from its original capture (which was Fishing Bay on Maryland’s Eastern Shore; Figure 5).

Project Summary, 2001- May 2007

From July 2001 to May 31, 2007 112 sea turtles (55 loggerheads, 53 Kemp’s ridleys and 4 greens) were examined as part of this project (Figure 7). Examinations occurred between May and October, with the majority in June and July.

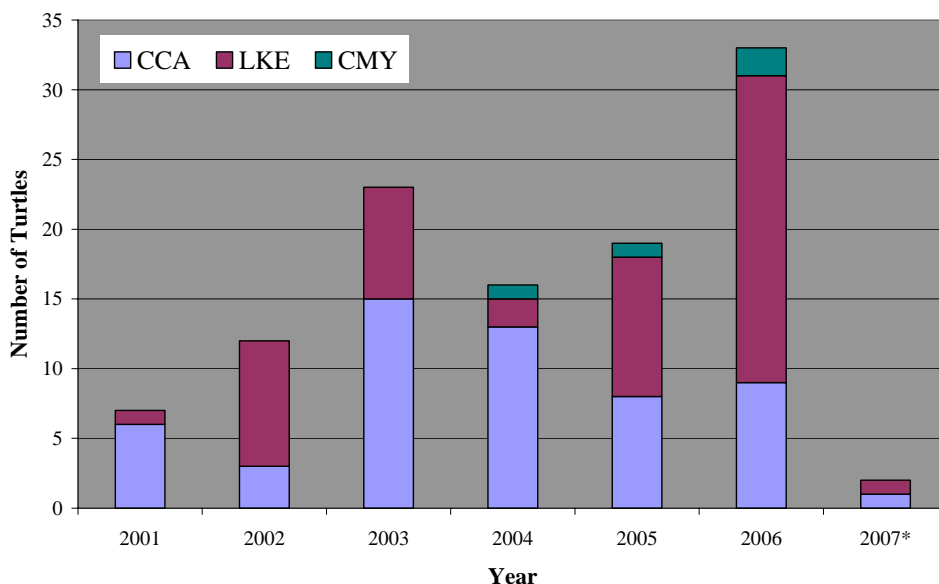


Figure 7. Yearly distribution of incidental captures of sea turtles by species from 2001 to 2007. * = only includes data from May 2007 as the grant period ended May 31, 2007.

The loggerheads ranged in size from 51.9 to 105 cm CCL (notch to tip). TEWG (1998) suggest that 92 cm SCL (approximately 98.6 cm CCL using Teas' 1993 equation for converting SCL to CCL) is a reasonable estimate of first maturity for loggerhead turtles based on data from nesting beaches. Using this number, approximately 94.5% of the loggerheads encountered in this study were immature. The Kemp's ridleys ranged in length from 29.4 to 57.2 cm CCL. Kemp's are generally accepted to mature at approximately 65 cm SCL (Zug *et al.*, 1995; approximately 68.8 cm CCL using equation in Teas 1993), so all animals in this project were likely immature. The greens ranged in size from 28.0 to 83.1 cm CCL. The mean size of female green turtles nesting in Florida is 101.5 cm SCL (Witherington and Ehrhart 1989), or approximately 108 cm CCL using Teas' 1993 equation. Based on this number three of the green sea turtles examined were juveniles, while one (83.1 cm CCL) was likely a subadult.

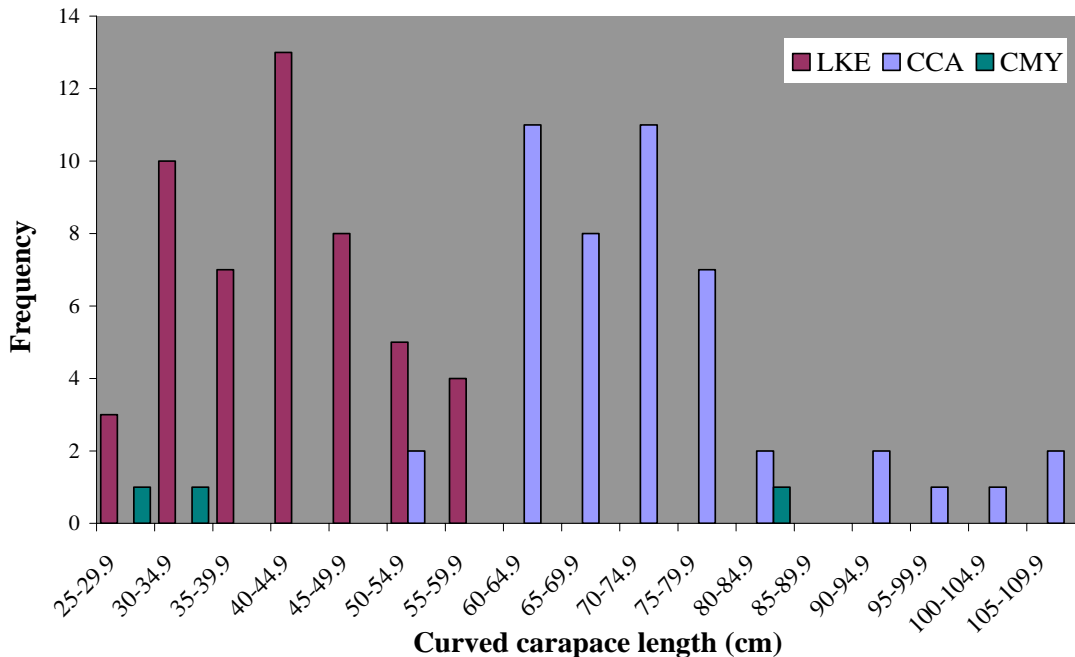


Figure 8. Length frequency distribution of sea turtles incidentally captured in pound nets in Maryland from 2001 to May 31, 2007.

Fourteen recaptures have occurred during the tagging project. Three sea turtles were previously tagged by other studies: a juvenile loggerhead tagged at the St. Lucie Power Plant in Florida traveled to the Chesapeake Bay over a period of 4 months in 2004; an adult female loggerhead migrated from a nesting beach along the Atlantic coast of Florida to the Chesapeake Bay; and a Kemp's ridley originally tagged by researchers at the NMFS Beaufort Lab in Core Sound, North Carolina in July 2004 was recaptured in the Chesapeake Bay in July 2006. These movements suggest that juveniles, and to a lesser extent, adults, utilize the Bay during the summer months, presumably as foraging grounds.

Of the 102 individual turtles encountered in this study, 11% were recaptured either within or between sampling seasons. Four loggerheads, two Kemp's ridleys and one green sea turtle were recaptured once and two loggerheads were recaptured twice. Several recaptures were recorded within a season, suggesting localized movements in the Bay during the summer months. Three loggerheads and a Kemp's ridley were re-encountered in subsequent years; two of the loggerheads and the Kemp's ridley were in the vicinity (less than 2.5 km) of their original capture sites. In fact, one loggerhead, which was encountered in 2003, 2004 and 2007, was found in three of the four nets fished northwest of Hoopers Island (indicated by red stars in Figure 6). These recaptures demonstrate site fidelity to specific locations over both consecutive and non-consecutive years.

Sample Collection and Analysis

Bloodwork

Blood samples were collected from 30 of the 35 turtles (28 of 33 in 2006 and 2 of 2 in 2007) examined and sent to Antech Diagnostics for analysis including a reptile chemistry panel, CBC, testosterone assay for sex determination, and parasitology. The reptilian comprehensive chemistry includes the following parameters: glucose, urea nitrogen (BUN), total protein, albumin, AST, calcium, phosphorus, sodium, potassium, chloride, globulin, CPK and uric acid. A report containing the results of the blood work analyses for each sea turtle was faxed to COL and entered into a Microsoft Excel spreadsheet.

A long-term objective of this project is to provide baseline blood values for sea turtles in Maryland to aid in establishing "normal" values for free-ranging loggerheads and Kemp's ridleys, which are generally lacking for wild populations (Bolten and Bjorndal 1992). Blood work data from 2001 to May 2007 were compiled and summarized. Descriptive statistics including mean, median, standard deviation, minimum value, maximum value, 1st quartile and 3rd quartile were calculated for each species and are presented in Tables 3 and 4. The minimum and maximum numbers provide a preliminary reference range by parameter for each species. The P.I. plans to continue collecting blood samples to increase the sample size and therefore the reliability of the range of normal values for Maryland. In the future MD DNR hopes to compare blood parameters from this study with previously published blood values for loggerheads and Kemp's ridley sea turtles. Furthermore, as the geographic and temporal scope of studies similar to this one continues to expand, collaborative efforts to synthesize and thoroughly analyze existing data should be pursued. A search of the existing published literature found few references for loggerhead blood values and even fewer for Kemp's ridleys. The results of this study could be particularly important for establishing baseline blood values for free ranging Kemp's ridley sea turtles.

Table 3. Descriptive statistics for 22 blood parameters for loggerhead sea turtles examined as part of the tagging and health assessment study, 2001 to May 31, 2007.

Blood Chemistry	n	Mean	SD	Min	Max	1st Quartile	Median	3rd Quartile
Albumin (g/dL)	48	1.31	0.43	0.70	2.50	1	1.2	1.6
AST (IU/L)	48	150.71	77.14	59.00	472.00	102.75	134.5	171.25
Calcium (mg/dL)	48	7.24	1.25	3.20	10.20	6.55	7.1	7.9
CPK (IU/L)	48	2732.58	4277.79	174.00	25020.00	795.25	1422	2459.5
Globulin (g/dL)	48	2.28	0.53	1.40	3.80	1.9	2.25	2.5
Glucose (mg/dL)	48	132.75	61.19	3.00	392.00	103.75	128	162.5
Phosphorus (mg/dL)	48	7.49	1.80	4.20	12.60	6.55	7.15	8.5
Total Protein (g/dL)	48	3.57	0.80	5.40	2.60	2.875	3.5	4.2
Uric Acid (mg/dL)	48	0.63	0.48	0.10	1.80	0.3	0.5	0.9
WBC (K/uL)	48	7.29	3.16	2.00	15.00	5	6.5	10
Urea Nitrogen	39	71.49	39.29	27	200	41.5	62	94.5
Sodium	39	153.18	5.86	140	169	150.5	154	156
Potassium	39	4.24	0.67	2.5	6	3.9	4.2	4.5
Chloride	39	106.54	7.1	93	126	103	107	110.5
Complete Blood Count								
HCT (%)	45	31.87	8.02	11.00	46.00	27	31	38
WBC	48	7.29	3.16	2	15	5	6.5	10
Heterophils	48	64.6	17.66	24	93	51	68	77.75
Lymphocytes	48	31.42	18.67	3	75	15	26	46.75
Monocytes	48	1.06	0.98	0	5	0	1	2
Eosinophils	48	0.35	0.86	0	5	0	0	0
Basophils	48	0.71	0.97	0	4	0	0	1
Azurophils	25	3.56	3.38	0	13	1	3	4

Table 4. Descriptive statistics for 22 blood parameters for Kemp's ridley sea turtles examined as part of the tagging and health assessment study from 2001 to May 31, 2007.

Blood Chemistry	n	Mean	SD	Min	Max	1st Quartile	Median	3rd Quartile
Albumin (g/dL)	45	1.40	0.43	0.80	3.60	1.2	1.3	1.5
AST (IU/L)	45	173.20	85.42	59.00	471.00	108	146	210
Calcium (mg/dL)	45	7.76	1.88	5.80	17.80	6.8	7.3	8.4
CPK (IU/L)	45	5179.88	7178.99	1.48	33210.00	1426	2303	5668
Globulin (g/dL)	45	2.09	0.59	1.20	4.80	1.8	2	2.4
Glucose (mg/dL)	45	122.27	58.09	3.00	324.00	87	112	155
Phosphorus (mg/dL)	45	8.14	2.02	5.50	15.30	7.2	7.8	8.9
Total Protein (g/dL)	45	3.48	0.96	2.20	8.40	2.9	3.3	3.8
Uric Acid (mg/dL)	45	0.88	0.57	0.30	2.80	0.5	0.7	1
Urea Nitrogen	35	82.8	30.14	34	168	61	77	100
Sodium	35	159.26	25.7	140	304	153	155	159
Potassium	35	4.95	2.93	3	20	3.9	4.3	4.85
Chloride	35	111.66	17.09	91	202	104.5	109	113.5
Complete Blood Count								
HCT (%)	44	31.70	8.92	12.00	67.00	27	29.5	33.5
WBC	44	7.65	4.29	2	22	4	7.8	10
Heterophils	44	62	22.61	14	92	41.75	69.5	79.5
Lymphocytes	44	38.25	42.39	4	270	14.25	25	56.25
Monocytes	44	1.57	1.55	0	7	1	1	2
Eosinophils	44	0.41	0.79	0	3	0	0	0.25
Basophils	44	1.02	4.08	0	27	0	0	1

Genetics

Tissue samples were collected from all of the loggerheads and the green sea turtle for genetic analysis. Because only ten loggerhead samples were collected during the grant period, MD DNR is archiving them until a larger sample size is reached. At that time (likely at the end of the 2007 sampling season), the samples will be submitted to Dr. Peter Dutton of the NMFS Southwest Fisheries Science Center in La Jolla, CA for analysis. Dr. Dutton began analyzing samples collected in this project from 2001 to 2005 earlier this year. Preliminary results for loggerheads indicated that most of the animals were haplotypes A-01 and A-02. Per Bowen et al (2004) haplotypes A-01 and A-02 are mainly found in nesting sites along the East Coast of the United States. Haplotype A-01 is found commonly in the Florida, Georgia, North Carolina, and South Carolina nesting sites and less frequently in the Dry Tortugas. Haplotype A-02 is found commonly in the Florida nesting sites and the Dry Tortugas. Currently, Dr. Dutton's lab is not able to confirm which beach a particular animal comes from because of the overlapping haplotypes on several of the nesting beaches. However, a more detailed analysis of loggerhead nesting sites is in the works and will provide additional information that is needed to help run a mixed stock analysis (Robin LeRoux, NOAA Fisheries, pers. comm.). At Dr. Dutton's request MD DNR will continue collecting biopsies until a sample size of approximately 100 individuals is achieved. This is the ideal number for a mixed stock analysis.

Contaminants Analysis

Another objective outlined in the Section 6 proposal was to expand the current scope of work to include contaminants analysis, specifically perfluorochemicals (PFCs). MD DNR proposed to submit archived blood samples to graduate students from the College of Charleston working in collaboration with NIST for analysis as time and funding at NIST permitted. In March 2007 Dr. Jennifer Keller of NIST notified Tricia Kimmel that she had secured funding for a graduate student to analyze MD DNR's archived blood samples for PFCs. Eighty-nine archived blood samples (46 loggerheads and 43 Kemp's ridley) were shipped to Dr. Keller in June 2007. PFC analysis will begin in the late summer or early fall. MD DNR continued collecting blood samples during the 2007 tagging season to send to NIST for this PFC project.

Outreach

The results of this project have been disseminated in numerous ways and to various user groups. A webpage (<http://www.dnr.state.md.us/fisheries/oxford/research/fwh/taggingstudy/index.html>) containing information on the tagging and health assessment study is maintained through MD DNR's website and kept up to date with numbers of animals examined and contact information for the P.I..

Tricia Kimmel co-presented a poster with personnel from NAIB's Marine Animal Rescue Program entitled, "The Integrated Approach of Government, Private Organizations, and Individuals to Facilitate Successful Rehabilitation of Sea Turtles in the Chesapeake Bay" at the 27th Annual Symposium on Sea Turtle Biology and Conservation in Myrtle Beach, South Carolina. The poster reviewed two case studies involving sea turtles with recreational fishing entanglements recovered from the pound net tagging and health assessment study (described earlier under Project Findings section). The turtles were examined by MD DNR biologists and transported to NAIB for treatment and rehabilitation. Both turtles were successfully treated and released with satellite transmitters. These two case studies reflect how cooperative relationships between local watermen, private stranding facilities, and government agencies are necessary to efficiently respond to, rehabilitate, and release entangled sea turtles in Maryland.

Ms. Kimmel provided information for an article on sea turtles that was published in Chesapeake Bay magazine in April 2007. The article discussed sea turtles in the Chesapeake Bay, highlighting the case study involving "Geddy," one of the two sea turtles encountered in the pound net tagging and health assessment study that had entanglement injuries. (see Project Findings section). The author gave an overview of the turtle's rehabilitation and release and provided information on the tagging study and what the public can do if they encounter a sick or injured sea turtle.

MD DNR personnel gave presentations highlighting the sea turtle tagging and health assessment study at several venues including the University of Pennsylvania Veterinary School, the MD DNR Natural Resources Police Academy, the Virginia-Maryland Regional School of Veterinary Medicine and at a NAIB Marine Animal Rescue Program volunteer meeting.

MD DNR personnel also disseminated information about sea turtles to the public at outreach events throughout Maryland. For the second year in a row, MD DNR staff participated in Oxford Day, a city-wide event held in Oxford, Maryland, where the COL is located. On April 28, 2007 COL was open to the public for tours, talks, activities for children and interactions with researchers from the facility. MD DNR offered an educational experience regarding sea turtles in the Chesapeake Bay through artifacts collected from stranded animals, species fact sheets, brochures, arts and crafts, and other various activities. More than 200 people toured the lab and interacted with MD DNR personnel.

In addition to large outreach events, several smaller groups of children visited COL during the grant period to learn about sea turtles in Maryland waters. MD DNR staff showed the children various bones and artifacts and talked to them about sea turtle biology, ecology and conservation. A group of college students from the NOAA Office of Education visited COL in August 2006 to learn about the various research programs at the lab. Tricia Kimmel spoke to the students about the tagging and health assessment study, specifically how the project operates and what type of information is collected from each sea turtle.

Expenditures

A summary of estimated expenditures to date can be found in Table 6.

Personnel

Section 6 funds were used to support 45% of the P.I.'s (Tricia Kimmel) annual salary and benefits. Ms. Kimmel oversees the tagging and health assessment study and was responsible for ensuring completion of project goals and objectives. Her duties included examining sea turtles and collecting samples, submitting samples for diagnostic analysis, maintaining the proper records for each animal, entering data into an Excel spreadsheet, attending scientific meetings and outreach events, training employees to assist with the tagging study, and securing and managing Section 6 funds to continue the project.

MD DNR also requested funds to continue supporting a portion (10%) of a Natural Resources Biologist's salary to assist with the tagging and health assessment study. Lauren Shilling assisted the P.I. with sea turtle examinations, sample and data collection and sample processing and submission.

Dr. Cindy Driscoll contributed a percentage of her time towards the tagging and health assessment study as in-kind match. She assisted the P.I. by conducting sea turtle examinations and sample and data collection in the field.

Supplies

MD DNR purchased supplies throughout the grant period including Passive Integrated Transponder (PIT) tags, flipper tags from the Archie Carr Center for Sea Turtle Research, wood and hardware to construct a sea turtle chair, Betadine surgical scrub and microtainer tubes for blood collection in the field.

Contractual Services

Blood samples were collected from 28 sea turtles and sent to Antech Diagnostics for a total of \$2,055.

Commercial watermen received financial compensation of \$75 per turtle for assisting with the retrieval and examination of an incidentally captured sea turtle, resulting in a total of \$2,475.

In the Section 6 proposal MD DNR budgeted funds for contractual services based on an estimate of 20 sea turtles. As discussed earlier, MD DNR biologists examined a total of 33 sea turtles in 2006. Therefore, MD DNR overspent this category by approximately \$1,460. To cover the cost of contractual services, MD DNR did not purchase a S-Plus license, estimated at \$2,100, as outlined in the grant proposal. Since this was less than 10% of the total amount of the grant, a budget amendment was not required (according to the grant agreement).

Travel

Tricia Kimmel and Lauren Shilling, a Natural Resources Biologist and support staff for this project, attended the 27th Annual Symposium on Sea Turtle Biology and Conservation in Myrtle Beach, South Carolina from February 24-28, 2007. Travel monies covered the cost of registration, meals, lodging and transportation.

Indirect Costs

The negotiated indirect cost rate at the time the grant was initiated was 28.5%. However, on July 1, 2006 the indirect rate dropped to 1.29%. As a result of the significantly lower negotiated cost rate the indirect charges were under spent, accounting for the balance of \$8,700 for the grant period.

Table 5. Summary of data collected from sea turtles examined during the tagging and health assessment study.

Accession Number	Species	Location	Exam Date	Curved Carapace Length (cm)	Weight (lbs).	Recapture	Samples		Tagging	
							Blood	Tissue	Flipper	PIT
06-PN-CC-01	Loggerhead	Pocomoke Sound	5/15/06	73.7	135 (e)	N	Y	Y	Y	Y
06-PN-CC-02	Loggerhead	Fishing Bay	5/30/06	72.0	65-70 (e)	N	Y	Y	Y	Y
06-PN-LK-03	Kemp's ridley	Fishing Bay	6/7/06	48.5	NT	N	Y	N	N	N
06-PN-LK-04	Kemp's ridley	Fishing Bay	6/7/06	41.9	20.1	N	Y	N	Y	Y
06-PN-LK-05	Kemp's ridley	Fishing Bay	6/7/06	32.8	10	N	Y	N	Y	Y
06-PN-LK-06	Kemp's ridley	Fishing Bay	6/13/06	29.4	7.0	N	Y	N	Y	Y
06-PN-LK-07	Kemp's ridley	Fishing Bay	6/15/06	37.4	13.5	N	Y	N	Y	Y
06-PN-LK-08	Kemp's ridley	Fishing Bay	6/15/06	41.7	18.6	N	Y	N	Y	Y
06-PN-LK-09	Kemp's ridley	Hoopers Island	6/19/06	29.6	7.7	N	Y	N	Y	Y
06-PN-LK-10	Kemp's ridley	Fishing Bay	6/22/06	42.6	42.6	N	Y	N	Y	Y
06-PN-LK-11	Kemp's ridley	Fishing Bay	6/28/06	48.2	33	N	Y	N	Y	Y
06-PN-LK-12	Kemp's ridley	Fishing Bay	6/28/06	34.6	11.6	N	Y	N	Y	Y
06-PN-CC-14	Loggerhead	Hoopers Island	7/6/06	52.3	41.7	N	Y	Y	Y	Y
06-PN-LK15	Kemp's ridley	Hoopers Island	7/12/06	50.8	36.7	N	Y	N	Y	Y
06-PN-LK-16	Kemp's ridley	Fishing Bay	7/12/06	39.4	18.3	N	Y	N	Y	Y
06-PN-LK-17	Kemp's ridley	Nanticoke River	7/12/06	55.1	50	N	Y	N	Y	Y
06-PN-LK-18	Kemp's ridley	Nanticoke River	7/12/06	39.0	14.9	N	Y	N	Y	Y
06-PN-CM-19	Green	Nanticoke River	7/12/06	28.0	5.8	N	Y	N	Y	Y
06-PN-LK-20	Kemp's ridley	Fishing Bay	7/13/06	55.0	43.1	N	Y	N	Y	Y
06-PN-LK-21	Kemp's ridley	Fishing Bay	7/13/06	42.2	42.2	Y	Y	N	Y	N
06-PN-CC-22	Loggerhead	Hoopers Island	7/17/06	65.1	80	N	Y	Y	Y	Y
06-PN-LK-23	Kemp's ridley	Fishing Bay	7/24/06	46.6	26.5	N	Y	N	Y	Y
06-PN-LK-24	Kemp's ridley	Fishing Bay	7/24/06	41	19	N	Y	N	Y	Y
06-PN-LK-25	Kemp's ridley	Fishing Bay	7/27/06	36.9	14.7	N	Y	N	Y	Y
06-PN-CC-26	Loggerhead	Fishing Bay	7/27/06	75.0	NT	N	N	N	N	N
06-PN-CC-27	Loggerhead	Hoopers Island	7/31/06	66.3	60 (e)	N	Y	Y	Y	Y
06-PN-CC-28	Loggerhead	Fishing Bay	7/31/06	68.2	75-80 (e)	N	Y	Y	Y	Y
06-PN-CC-29	Loggerhead	Fishing Bay	8/14/06	55	45	Y	Y	N	N	N
06-PN-LK-30	Kemp's ridley	Fishing Bay	8/14/06	34.2	9.8	N	N	N	Y	Y
06-PN-CM-31	Green	Fishing Bay	8/14/06	29.5	4.2	Y	N	N	N	N
06-PN-CC-32	Loggerhead	Fishing Bay	8/22/06	82.0	173	N	N	Y	Y	Y
06-PN-LK-33	Kemp's ridley	Hoopers Island	8/29/06	43.2	22.2	N	Y	N	Y	Y

Table 6. Total Expenditures for NOAA Grant No. NA06NMF4720040 from June 1, 2006 to May 31, 2007.

Category	Federal Share	State Share	Total	Total Expenditures	Remaining Funds
Salary & Fringe	\$27,552	\$11,380	\$38,932	\$42,431	\$(3,499)
Travel	\$1,664	\$0	\$1,664	\$1,186	\$478
Equipment	\$0	\$0	\$0	\$0	\$0
Supplies	\$1,131	\$0	\$1,131	\$593	\$538
Contractual	\$3,070	\$0	\$3,070	\$4,530	\$(1,460)
Other	\$2,600	\$420	\$3,020	\$24	\$2,996
Total Direct Charges	\$36,017	\$11,800	\$109,149	\$48,764	\$(947)
Indirect Charges (*)	\$7,756	\$3203	\$10,959	\$1,139	\$9,820
TOTAL	\$43,773	\$15,003	\$58,776	\$49,903	\$8,873

Federal Share 75% \$37,490
State Share 25% \$12,497

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